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Soft X-ray Emission Studies of Calcium Copper Titanate

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Beamline(s): X1B

Introduction: Calcium copper titanate ($CaCu_3Ti_4O_{12}$) CCTO, a perovskite material, has come under close scrutiny due to a giant dielectric effect observed in this material at low temperature. [1] The techniques of soft x-ray emission (SXE) and soft x-ray absorption (SXA) spectroscopy are applied here at room temperature.

Methods and Materials: Thin films of $CaCu_3Ti_4O_{12}$ were produced by pulsed laser deposition onto $LaAlO_3$ substrates. These films were then studied in vacuo by the techniques of soft x-ray emission and soft x-ray absorption spectroscopies at beamline X1B using a high resolution x-ray emission spectrometer.

Results: Soft x-ray emission and absorption spectra were recorded at the O *K*-edge, the Ti *L*-edge, and the Cu *L*-edge. Fig.1 shows the O *K*-edge SXA spectrum and the accompanying O SXE spectra obtained at the indicated points where the dark blue spectrum shows increased emission around 532eV. Shown in Fig.2 are the Ti *L*-edge SXA spectrum and the accompanying Ti SXE spectra obtained at the indicated points. This illustrates the effect of resonant inelastic x-ray scattering (RIXS) in titanates and shows many features in common with other titanium based perovskites. [2] The initial Ti SXE spectrum peaked at 449eV corresponds to excitation from the hybridized O-*2p*/Ti-*3d* valence band to mostly Ti *3d* final states and can be seen at a constant energy loss to the elastically scattered peak.

Conclusions: The Ti RIXS spectra of calcium copper titanate can be explained on the basis of radiative and non-radiative electronic processes near the Ti $L_{2,3}$ edge.

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References:

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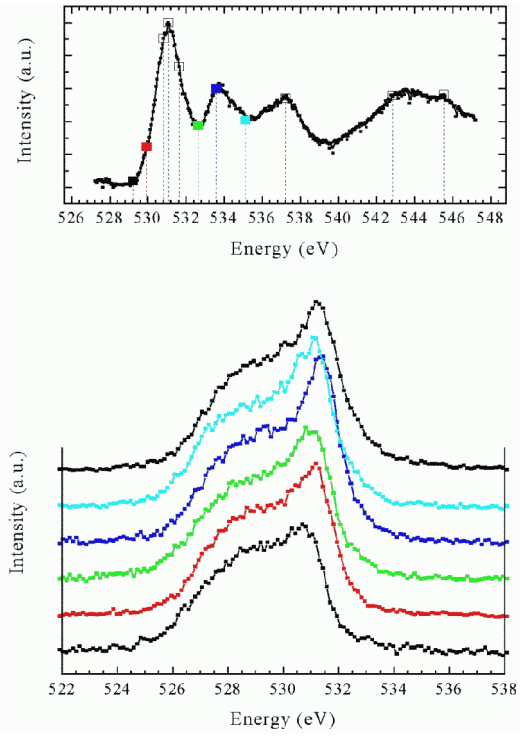

Figure 1 O *K*-edge SXA spectrum (top) and SXE spectra (bottom) of CCTO. Colors of SXE spectra refer to excitation energies.

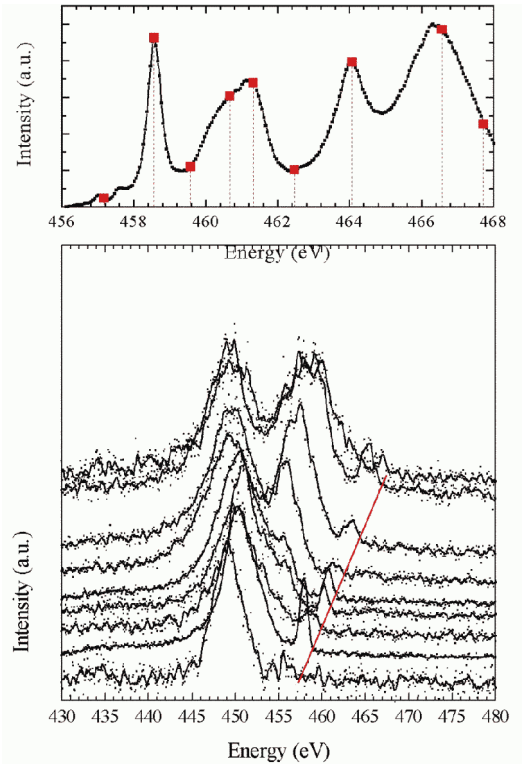

Figure 2 Ti *L*-edge SXA spectrum (top) and Ti SXE spectra (bottom) of CCTO. The line is a guide to the excitation energy.